The Role of Quality in Enhancing Program Success

event
date

briefer
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Acknowledgment

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Quality Matters

V-22 Osprey story

USS Thresher story

Firestone tire story

Flaw Could Shorten Raptors' Lives
The News Herald, Panama City, Fla. May 3, 2006

"Officials discovered that the titanium components [of the forward boom frames]
may have been improperly treated, creating the possibility that the metal would
not last as long as it is supposed to. … This is not a result of improper design,
but an issue with one supplier's manufacturing process."

therefore • • •

Industry is Adopting a New Paradigm for Quality

- **Quality is no longer limited to a centralized functional organization for:**
  - **Auditing / compliance with standards (certification)**
  - **Implementation of a quality management system**
  - **Inspections / searching for defects**

- **Today, quality engineers/SMEs are typically matrixed to a product or project early in development**
  - **Integrated with the IPTs**
  - **Closely linked with a company's process improvement initiatives**
  - **Assess if processes are working as designed**

Process carelessness leads to technical risk

What Risks Can Quality Help Identify and Mitigate?

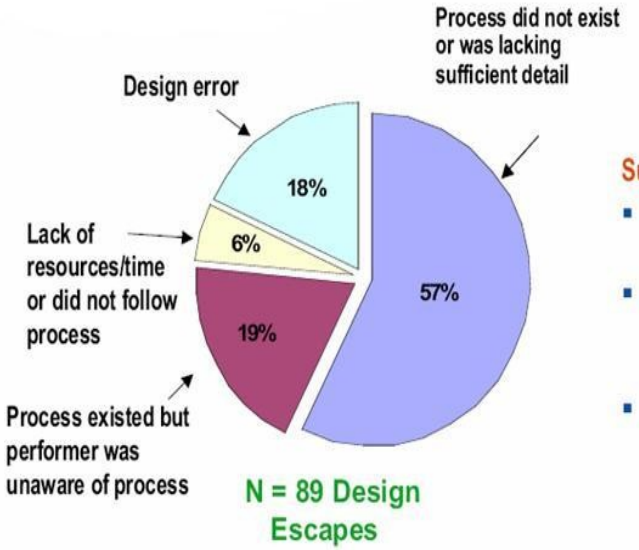
Quality engineers/SMEs can help identify situations_

- **Inappropriate application of technical processes and/or inadequate procedures**
- **Ineffective supplier management**
- **Ineffective customer engagement**
- **Unidentified verification technologies**

. . . that may lead to potential risks to be mitigated

- **Ill-defined requirements, a breakdown in requirements flow down, or uneconomically producible designs**
- **Suppliers with inadequate capabilities; decreasing leverage with subtiers**
- **Dissatisfied customers**
- **Undetected product defects**

Analyses Show Prevalence of Process-Based Risks


Process did not exist or was lacking sufficient detail
Design error
18%
Lack of resources/time or did not follow process
6%
57%
19%
Process existed but performer was unaware of process
N = 89 Design Escapes

Summary Root Causes

- Lack of clear standard design process
- Insufficient process compliance accountability and enforcement requirement
- Ineffective design reviews

Root cause analysis showed 82% of design escapes attributed to "no established process" or "process non-compliance"

Presented by Lisa Kohl
Vice President, Northrop Grumman Space Technology
Lean Aerospace Initiative Plenary Conference
23-24 March 2004

Presented by Joseph Adams
Vice President Engineering, Pratt & Whitney
Lean Aerospace Initiative Plenary Conference
23-24 March 2004

Why are these Risks Important?

- **If not managed and mitigated, these risks may start a chain of events resulting in undesirable outcomes**
  - **Product defects discovered in production or testing lead to expensive and time-consuming rework**
  - **Product may not meet customer needs**
  - **Product failures discovered in the field lead to degraded mission effectiveness or mishaps**
- **The later these risks are identified, the greater the cost of corrective action and the**

arly identification, management, and mitigation of importa
ocess-based risks to a program leads to less expensive and l
disruptive preventive actions that break the chain of event

Best Practices for Reducing Process-Related Risk to a Program

- **Early Quality involvement with the product line to ensure that processes are implemented correctly**
- **Create conditions that encourage the entire workforce to focus on quality along with cost, schedule, and performance**
- **Develop strong linkages between the quality engineers/SMEs on the product or project and the SE technical reviews**

D should encourage industry to apply these best practices a follow them consistent with its oversight responsibilities

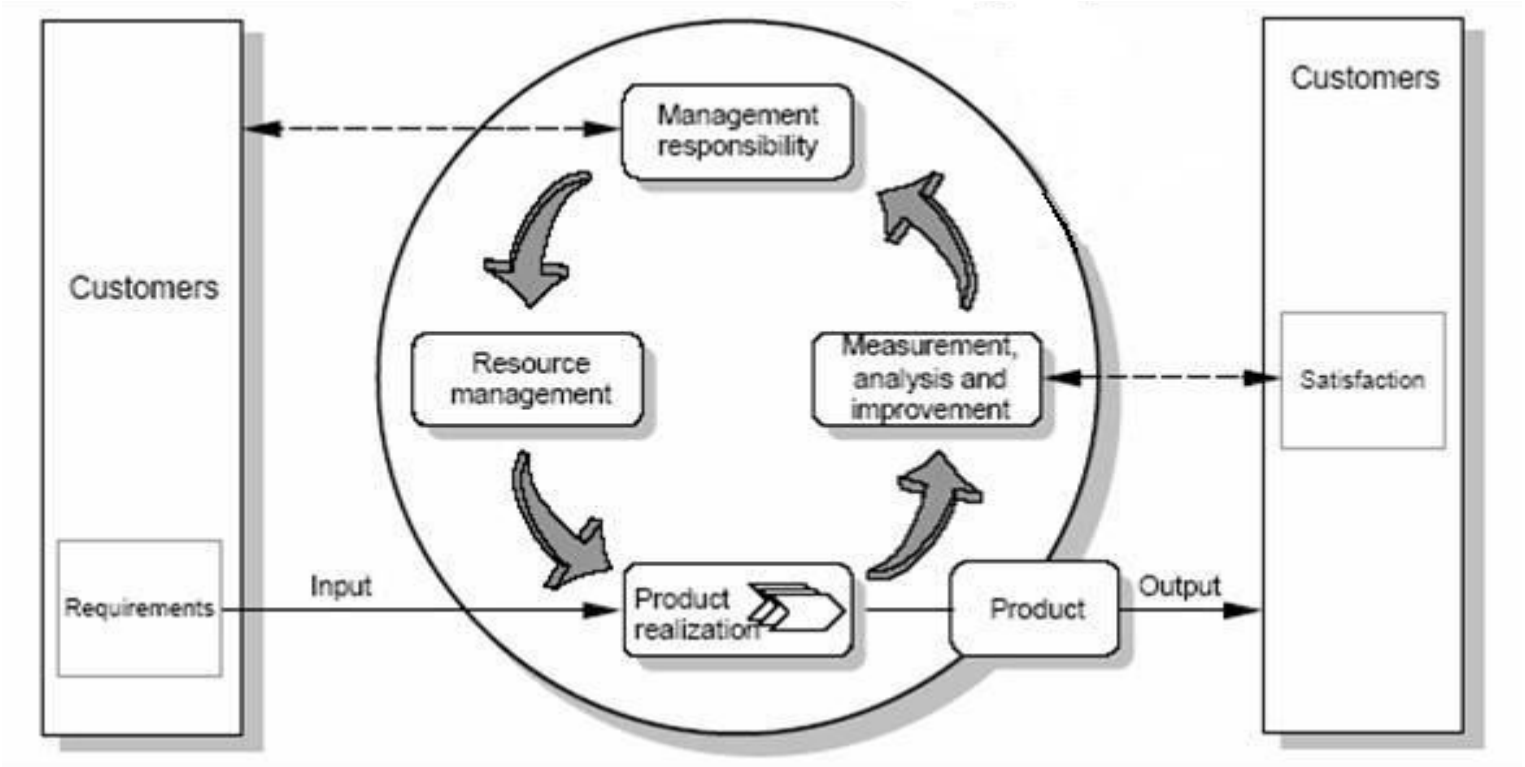
Early Quality Involvement (slide 1 of 3)

- A “process approach” is the identification, interaction, application, and management of a system of processes over the life cycle
- Quality engineers/SMEs involvement means implementing processes correctly in order to
  - Understand and meet requirements
  - Evaluate processes in terms of value added
  - Obtain results of process performance
  - Improve performance based on objective measurement

Don’t wait for production before engaging Quality;
Don’t delay interactions until there is a

Early Quality Involvement (slide 2 of 3)

ISO's Model of a Process Based QMS



Early systematic use of a process based quality management system (QMS) improves outcomes

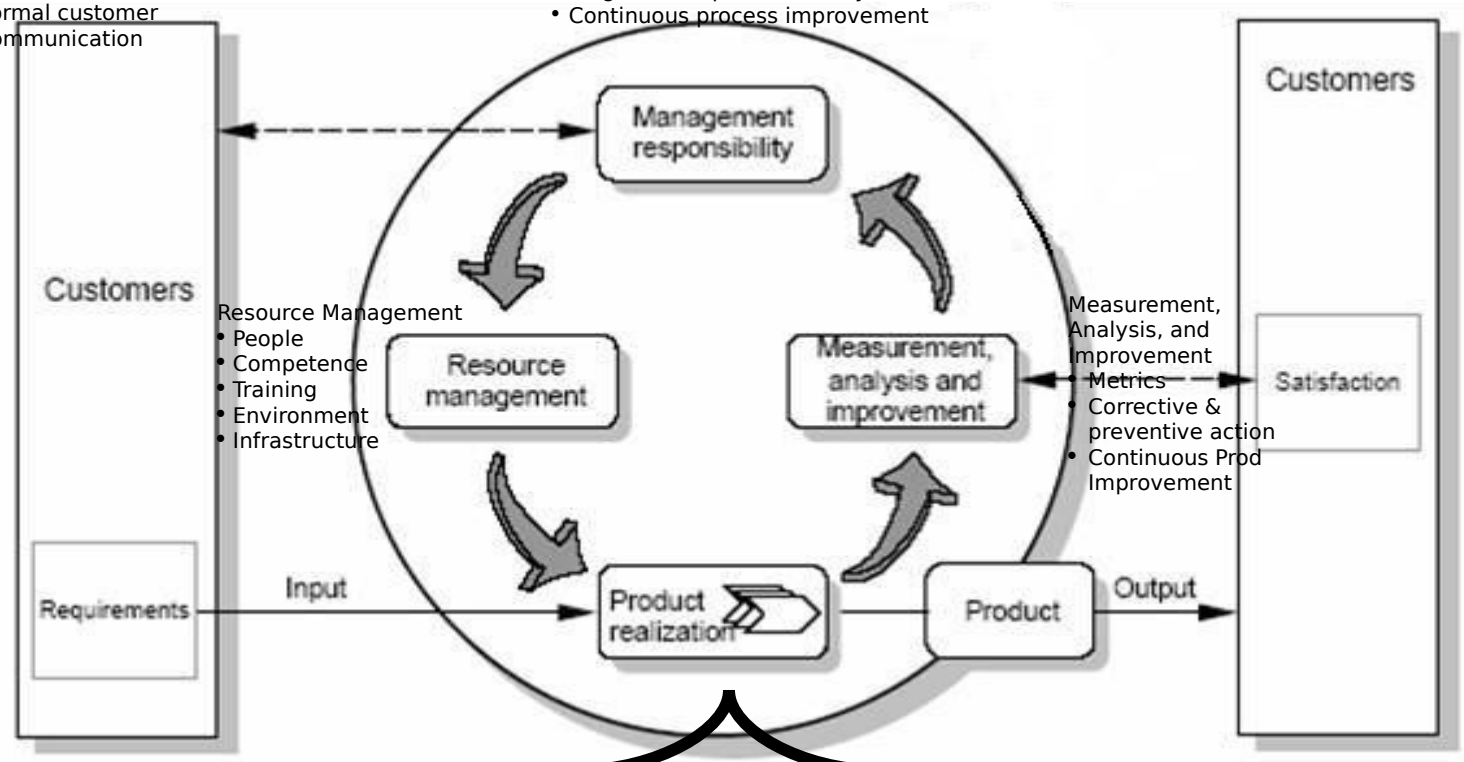
Early Quality Involvement (slide 3 of 3)

A Process Based QMS's Interactions with a Program

Customer Requirements
- Product requirements documentation
- Program cost and schedule performance data
- Formal customer communication

Management Responsibility
- Management Review
- Quality policy
- Customer focus
- Risk, issue & opportunity mgmt
- Program Independent Analysis
- Continuous process improvement

Customer Satisfaction
- Customer Reporting
- Training System
- Publications
- Post delivery support



Resource Management
- People
- Competence
- Training
- Environment
- Infrastructure

Measurement, Analysis, and Improvement
- Metrics
- Corrective & preventive action
- Continuous Prod Improvement

Systems Engineering
- Prod Reqts Alloc
- Allocation, verification & validation plan
- Configuration, data, risk mgmt

Software Engineering
- Design
- Integration
- Code
- Testing

Integrated Product Definition
- Design
- Specialty Engineering
- Support Functions

Product Support
- Performance based logistics
- Field support requirements

Test Engineering
- Test reqts
- Test planning
- Test conduct
- Reports

Supplier Management and Procurement
- Purchasing process
- Purchase order reqts
- Purchase process verification

Manufacturing Engineering
- Manufacturing and inspection work instructions
- Producibility
- Work flow

Manufacturing Product
- Fabrication
- Assembly

Encourage Quality Focus (slide 1 of 3)

- ***Values*** **are ideas or things accepted as good, desirable, and important as codified by policy and guidance**
  - **Example: "nothing goes out the door if it's not done right"**
- ***Beliefs*** **are what people really think**
  - **Example: people do not ask penetrating questions in meetings to avoid elevating issues**
- ***Behaviors*** **are what the workers really do**
  - **Example: due to schedule or cost pressures, workers draw conclusions from incomplete or inadequate data thereby accepting, ignoring, underestimating,**

Avoid mismatches among values, beliefs and behaviors

Adapted from David Leetsma, Manager Advance Planning Office, Johnson Space Cent
as presented to the 2006 Conference on Quality in the Space and Defense Industries

Encourage Quality Focus (slide 2 of 3)

Emphasis in the ISO Context

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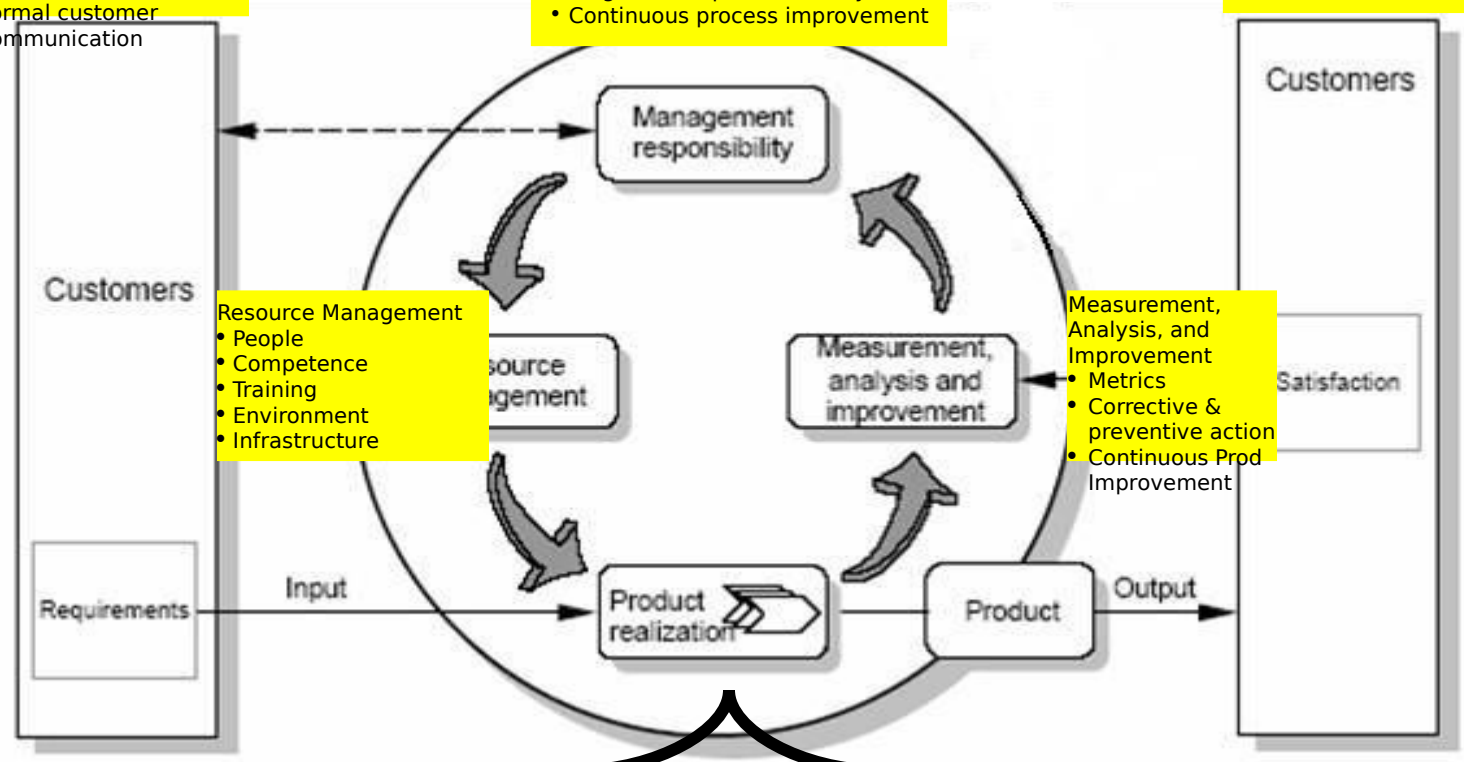

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Encourage Quality Focus (slide 3 of 3)

Understand/Evaluate Key Practices

At Program Startup

- **The process for establishing the product or project Quality budget**
- **Where Quality responsibility is placed in the program**
- **How quality skills have been assigned to the project**
- **The process for analyzing quality requirements and mitigating associated risks**
- **The quality strategy's consistency with industry best practices**

Throughout the Life Cycle

- **How management uses quality data**
- **The contractor's approach for continuous process improvement**
- **The contractor's approach for preventive and corrective action**
- **The contractor's approach for achieving customer satisfaction**

DoD should encourage and participate with industry to apply effective practices in these areas

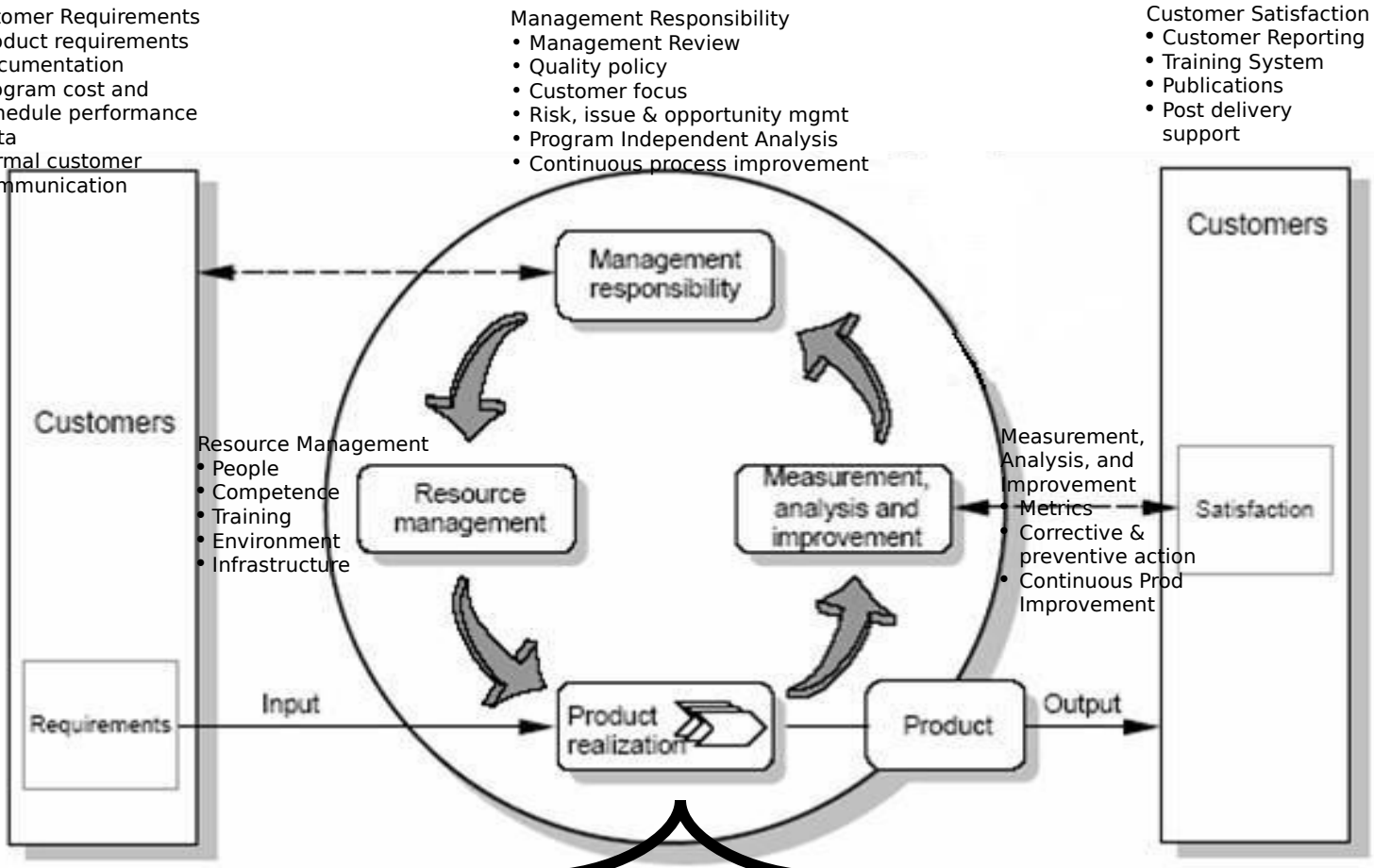
Develop Strong Linkages to the SE Technical Reviews (TRs) (slide 1 of 4)

- **The purpose of these reviews is to provide the program manager with an integrated technical assessment of program technical risk and readiness to proceed to the next technical phase of the effort**
- **Process-based technical risks affect readiness to transition**
  - **System engineers develop, manage and execute processes**
  - **Quality engineers independently assess if they are working as designed**

Develop Strong Linkages to the SE TRs

(slide 2 of 4)

Emphasis in the ISO Context



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Develop Strong Linkages to the SE TRs

(slide 3 of 4)

Best Practices Check List Process Description

- **For each component of the product realization process tailor questions to the specific situation for the technical review**
- **Questions should be posed to the prime contractor and the principal subs during their technical reviews**
- **Based on the answer to each question, assign a red-yellow-green indicator to reflect an assessment of the situation**

Develop Strong Linkages to the SE TRs

(slide 4 of 4)

Best Practices Check List Process Description

cont'd

- **Situation should be summarized at prime's technical review with DoD**
  - **Summary could be done using the eight categories of the product realization process**
  - **Further aggregations may be made, e.g.,**
    - **Product development**
    - **Software development**
    - **Verification and validation**
    - **Supplier management**
    - **Manufacturing**
  - **Utilize a red-yellow-green scale**
  - **Mitigation actions underway (if needed) should also be presented**

Factors behind "encourage quality focus" evaluation areas

The Process for Establishing the Product or Project Quality Budget

Example evaluation considerations:

- **Project quality administration, product verification, quality engineering (hardware and software), quality planning, and supplier quality**
- **Specific quality deliverables**
- **Capital, equipment, and software verification needs**
- **How the estimates are modified when there are changes to the strategy and/or scope of the program**
- **Measurement technology needs**

Where Quality Responsibility is Placed in the Program

Example evaluation considerations:

- **Role in the general risk identification, classification, and mitigation process**
- **Involvement in the design change control and release process**
- **Role in processing waivers, deviations and engineering change proposals**
- **Representation on Integrated Process Teams and boards (e.g., change control board, risk) for all product and process development activities**
- **Involvement in test plans, material reviews, build/buy/support to packages**
- **Participation in the integration of inspection points into processing and test documentation**
- **Role in the supplier management, development, incentivization, and control process**

How Quality Skills Have Been Assigned to the Project

Example evaluation considerations:

- **The process to identify the need for quality management, quality engineering (hardware and software), quality planning, supplier quality, and product verification skills across the life cycle**
- **The process to identify quality skills and any associated certifications and qualifications**
- **The process for addressing quality staffing ratios and skill shortfalls**

The Process for Analyzing Quality Requirements and Mitigating Associated Risks

Example evaluation considerations:

- **The process for identifying and achieving quality tasks in support of contract deliverables**
- **How a post award contract analysis for Quality's tasks was performed / has been updated**
- **An evaluation of how the Quality plan matches the program requirements and their integration across program sites, IPTs, partners and suppliers**
- **How quality activities factored into the Integrated Master Plan and Integrated Master Schedule**

The Quality Strategy's Consistency with Industry Best Practices

Example evaluation considerations:

- **The use of lessons learned**
- **How similar programs' quality past performance have been reviewed**
- **How the quality plan addresses program unique processes**
- **How plans include verification approaches, nonconformance handling, operator verification manufacturing self-examination, nondestructive inspection, manufacturing systems, measurement approach, special measuring and test equipment**
- **Adequacy of the quality plan to address all other program plans (manufacturing, systems engineering, subcontract management, delivery, …)**
- **Periodic review and update**
- **Early involvement in the program**

How Management Uses Quality Data

Example evaluation considerations:

- **Audit needs and addressing audit findings**
- **The process for analyzing and performing trend analysis of internal/external audit findings**
- **How quality is defined, measured, analyzed, controlled, and used to drive management decisions and actions on the program**
  - **The process for developing and identifying requirements for quality metrics and measurement systems**
  - **The system for monitoring supplier performance, including their product development activities**
  - **The process for review and update**

The Contractor's Approach for Continuous Process Improvement

Example evaluation considerations:

- **Baldridge business model**
- **CMMI**
- **Lean**
- **Six sigma**
- **ISO recertification**
- **Actions taken to address feedback from assessments performed**

The Contractor's Approach for Preventive and Corrective Action

Example evaluation considerations:

- **The process for addressing test and inspection findings and discrepancies**
- **The process for addressing supplier nonconformances**
- **Establishment and maintenance of a closed loop corrective action system that includes the reporting, root cause analysis, and implementation of actions necessary to correct and preclude recurrence of problems, failures, quality issues, defects/nonconformances**
- **The process for using lessons learned to drive continuous improvement**

The Contractor's Approach for Achieving Customer Satisfaction

Example evaluation considerations:

- **The process to collect, monitor, and analyze information for measuring customer satisfaction**
- **The process to rapidly mitigate customer concerns**
- **The process to communicate with customers at all levels**
- **The process / organizational structure for reacting to customer inquiries and needs**